



How to Feed PROTEINS IN WARTIME

Prepared by

Oklahoma A. and M. College
Livestock, Dairy, and Poultry Staffs

and Concurred in by

The Livestock, Dairy, and Poultry Organizations
and the Feed Industry
of Oklahoma

OKLAHOMA AGRICULTURAL EXPERIMENT STATION

Oklahoma A. and M. College, Stillwater

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Experiment Station Circular No. C-113

July, 1943

In Reply to Your Request—

This publication represents the response of feeding authorities at the Oklahoma A. and M. College to numerous requests from livestock, dairy and poultry organizations, individual producers, and the feed industry of Oklahoma for methods of meeting wartime protein shortages.

In these pages, directions are set forth for meeting the protein feed problems on the farm or ranch and in the feed lot, and for meeting it in the way which most nearly provides at least minimum protein requirements as shown by feeding tests at this and other experiment stations.

A preliminary manuscript of this publication was reviewed by representatives of the livestock, dairy and poultry organizations of the state, and by representatives of the state's feed industry. Many of their suggestions are incorporated in the final publication, and their cooperation is much appreciated.

W. L. Blizzard

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Protein Is Wasted by Feeding Too Little or Too Much of It.

Shortage of protein supplements makes it essential to get full value from each pound fed. Feeding too little protein, too much protein, or protein of the wrong kind actually increases the total amount of protein—and other feeds as well—required to produce a pound of meat or a dozen of eggs or a gallon of milk. That would waste labor as well as feed and reduce the total quantity of food produced.

It is false economy to feed a ration which contains too little protein. There must be proper balance between protein and other feeds to get maximum benefit from either the protein or the other feeds. Adequate protein is necessary for rapid growth and development of young animals and birds, for more efficient digestion of all feed eaten, for increased fertility in breeding flocks and herds, and for greater resistance to diseases and parasites.

Right Amount for Fewer Head Will Increase Total Production

Feeding fewer animals or birds an adequate ration will make better use of labor and equipment than can be made by feeding larger numbers a sub-standard ration. Even more important, TOTAL PRODUCTION WILL BE GREATER. A certain amount of feed—the body maintenance requirement—is needed to keep the animal or bird alive and active. Additional feed goes into production of meat, milk, or eggs. Limited total feed supplies will turn out maximum food production when that portion of the feed required for body maintenance is held to a minimum. This can be done by limiting animal numbers in line with what the available feed supplies will properly support.

Livestock and poultry which cannot be fed for maximum production will help the nation more in the packing plant than on the farm.

An excess of grain will compensate only in part for a shortage of protein. Animals have specific protein requirements. Economical production with farm grains can be obtained only by adding the necessary protein supplements.

Protein supplements vary in the quantity, quality, and digestibility of their total protein content. Commercial protein supplements are sold on a guaranteed total protein content. The animal sources of protein are more digestible than plant sources and have nutritive properties that are essential young growing pigs. These factors have all been considered in preparing these livestock feeding recommendations.

Some Protein Can Be Produced at Home.

Home production of protein will help increase food production nationally, and will also help relieve the individual feeder or flock owner of dependence on outside sources during the present shortage. Here are some suggestions:

1. Good pastures conserve protein. Pasture grass is the cheapest as well as the best source of protein.
 - A. Use temporary pasture crops such as sudan grass to supplement native pastures.
 - B. Make maximum use of stubble fields, meadow aftermath, etc.
 - C. Arrange fall, winter, and early spring pasture (Barley, wheat, rye, rye grass). Cereal pastures have a higher protein content than alfalfa hay.
 - D. Use pastures while growth is rapid. As pasture grasses mature, they decline markedly in protein content.
2. Legume hay reduces the need for purchased protein.
 - A. Cut alfalfa at early bloom stage. Conserve leaves and green color in curing.
 - B. Where possible, plant annual legumes for hay.
 - C. Use peanut hay when available. Feeding value of peanut hay will be much higher if the vines are carefully cured by stacking them around poles instead of windrowing them. Preliminary results of a single feeding trial conducted at this station indicate that good peanut hay has about the same feeding value as good alfalfa hay.
3. Cut native and non-legume hay just prior to heading stage. Hay cut at the proper stage and properly cured contains three times as much protein as stemmy late-cut hay. Conserve the green color for vitamin A.
4. Make maximum use of home produced proteins such as skim milk, buttermilk, etc. Mungbeans (cracked and not saleable) can be used to replace purchased supplements.

BEEF CATTLE

Protein Requirements

Table I gives the amount of protein supplement needed for various classes of beef cattle in the long-grass area. Less will be required in the short-grass area. The supplement may be cottonseed meal or cake, linseed meal, soybean meal, peanut meal, or a mixture containing the amount of protein contained in these meals.

Ways of Conserving Proteins

To reduce the amount of high protein feed purchased:

1. Use all the green pasture possible. No protein supplement is needed for cattle being grazed on wheat, barley, rye, rye grass, or other winter pasture, or on good green native grass or temporary pasture.

TABLE I.—*The Protein Supplement Requirements of Beef Cattle.*

	POUNDS OF PROTEIN SUPPLEMENT PER HEAD DAILY:			
	With corn silage, good prairie hay, or similar roughages	With old grass or other low- quality roughages	With alfalfa hay or other good legume hay	With green pasture
Wintering:				
Breeding cows to calve in spring	.5	1.5	None	None
Cows nursing calves	1.5	2.0-3.0	None	None
Calves and yearlings	1.0	1.5-2.0	None	None
Aged steers, wintering	.5	1.0-1.5	None	None
Fattening:				
Calves and yearlings	1.5-2.0	2.5	0.0-1.0	None
Aged cattle	1.0-2.0	2.5-3.0	0.0-1.0	None

2. Use alfalfa hay. Wherever practicable, 3 to 4 pounds of good quality alfalfa hay should be substituted as a source of protein for one pound of cottonseed cake or similar protein supplement when fed with good roughage.
3. Where protein supplements are not available, use farm grains. Oklahoma, Kansas, and Nebraska tests indicate that about two pounds or a little more of ground wheat, grain sorghums, oats, barley, or corn may be used as a substitute for one pound of cottonseed cake for wintering cattle fed good roughage.

SHEEP

Protein Requirements

Table II gives the protein requirements of sheep. The supplement may be any of those listed for beef cattle.

TABLE II.—The Protein Supplement Requirements of Sheep.

	POUNDS OF PROTEIN SUPPLEMENT PER HEAD DAILY:		
	With corn or kafir silage, good prairie hay, or similar roughage	With old grass or other low- quality roughage	With alfalfa or other good legume hay
Pregnant ewes	$\frac{1}{4}$	$\frac{1}{3}$	None
Ewes nursing lambs	$\frac{1}{3}$	$\frac{2}{5}$	None
Breeding lambs (weaned)	$\frac{1}{3}$	$\frac{2}{5}$	None
Fattening lambs in dry lot	$\frac{1}{3}$	$\frac{2}{5}$	None
Fattening lambs on wheat pasture	None	None	None
Mature rams and non-pregnant ewes	$\frac{1}{8}$	$\frac{1}{4}$	None

Ways of Conserving Proteins

- To reduce the amount of high protein feed purchased:
1. Use good quality hay. If legume hays are not of good quality, .1 to .2 pounds of protein supplement is advisable.
 2. Use no protein supplement for breeding ewes or lambs running on good pasture.
 3. Use no protein supplement for nursing lambs.
 4. Use mungbeans to supply at least one-half of the protein supplement requirement of sheep. They are not palatable enough to furnish all the protein needed, at least for fattening lambs.

HOGS

Protein Requirements

Protein supplement mixtures for hogs should contain the amount of animal protein required for satisfactory results. During the present emergency, the amount of animal protein should be kept at a minimum. Tables III and IV show how to figure a minimum of animal protein for the grain being used.

To use Table III (for hogs in dry lot), look up the pounds and kind of supplement for the kind of grain being used and

TABLE III.—The Protein Supplement Requirement of Hogs in Dry Lot.

	Percent- age of protein needed in ration	Supple- ment to use (See page 8	POUNDS OF SUPPLEMENT PER 100 LBS. OF MIX: ¹			
			With corn	With ground wheat	With ground barley	With ground kafir
Pigs up to 50 lbs.	20	A	28	23	25	26
Pigs 50 to 80 lbs.	18	A	24	15	18	20
Pigs 80 to 120 lbs.	16	A	19	9	12	14
Pigs 120 to 165 lbs.	14	B	13	4	6	8
Pigs 165 to 220 lbs.	12	B	7	3*	3*	5
Bred sows ²	14	B	13	4	6	8
Nursing sows	15	B	16	7	9	12
Breeding gilts and boars	15	B	16	7	9	12

¹ Five percent alfalfa meal should be included in all rations fed to growing and fattening pigs in dry lot.

² In feeding sows, ground alfalfa hay can be used to advantage up to 15 percent of the ration if the alfalfa is high quality, fine-stemmed, and leafy.

* The percentage of protein supplement in these rations was not reduced below 3 percent in order to keep up the quality of the protein in the ration.

EXAMPLE: Feeding ground wheat to pigs weighing 50 to 80 pounds, in dry lot—Use the line, "Pigs 50 to 80 lbs." On that line, under "Supplement to use," is "A," and under "With ground wheat" is "15." So in making the feed mixture, start with 15 pounds of Supplement A, which is given on page 8. Add 5 pounds of alfalfa meal, making 20 pounds. Subtract the 20 pounds from 100, which gives 80 pounds—the amount of ground wheat needed for 100 pounds of mixture.

TABLE IV.—The Protein Supplement Requirement of Hogs on Pasture.

	Percent- age of Protein Needed in Ration	Supple- ment to use (See page 8	POUNDS OF SUPPLEMENT PER 100 LBS. OF MIX			
			With corn	With ground wheat	With ground barley	With ground kafir
Pigs up to 50 lbs.	18	A	24	18	19	20
Pigs 50 to 80 lbs.	16	A	18	11	12	14
Pigs 80 to 120 lbs.	14	B	13	5	7	9
Pigs 120 to 165 lbs.	12	B	8	3*	3*	4
Pigs 165 to 220 lbs.	10	B	3*	3*	3*	3*
Bred cows ¹	12	B	8	3*	3*	4
Nursing sows	13	B	11	3*	4	5
Breeding gilts and boars	13	B	11	3*	4	5

¹ In feeding sows, ground alfalfa hay can be used to advantage up to 15 percent of the ration if the alfalfa is high quality, fine-stemmed, and leafy.

* The percentage of protein supplement in these rations was not reduced below 3 percent in order to keep up the quality of the protein in the ration.

EXAMPLE: Feeding corn to pigs weighing 80 to 120 pounds, on pasture—Use the line, "Pigs 80 to 120 lbs." On that line, under "Supplement to Use," is "B," and under "With corn" is "13." So in making the feed mixture, simply add 87 pounds (100—13=87) of corn to 13 pounds of Supplement B to make 100 pounds of feed mixture. Supplement B is described on page 8.

the weight of the pigs. To this amount of supplement, add five pounds of alfalfa meal, and the remainder of the 100 pounds of ration will be the available grain.

Table IV (for hogs on pasture) is used in the same way except that the alfalfa meal can be omitted.

Examples of how to figure rations are given in footnotes to the tables. Supplements A and B in Tables III and IV are made up as follows:

<i>Supplement A</i> (46.0% crude protein)	
Meat scraps (50% protein)	50. lbs.
Soybean oil meal (41% protein)	25 lbs.
Cottonseed meal (43% protein)	25 lbs.
	100 lbs.
 <i>Supplement B</i> (44.7% crude protein)	
Meat scraps (50% protein)	34 lbs.
Soybean oil meal (41% protein)	33 lbs.
Cottonseed meal (43% protein)	33 lbs.
	100 lbs.

Soybean oil meal should be well cooked for best results in hog feeding. The alfalfa meal should be leaf meal or extra choice alfalfa meal.

A mineral mixture of two parts (by weight) of finely ground limestone and one part flake salt should be fed free choice. Bone meal, which is now difficult to procure, is not necessary for hogs being fed the rations recommended here.

In case it is impossible to secure meat scraps, skim milk, or any other source of animal protein, a mixture of equal parts of soybean oil meal and cottonseed meal could be used, or soybean oil meal can be used alone. Peanut meal may be substituted for either soybean meal or cottonseed meal. The omission of animal protein will reduce the gain and increase the feed required per pound of gain.

Ways of Conserving Proteins

To reduce the amount of high protein feed purchased:

1. Use green, growing pasture. The use of good green pasture will eliminate the need for alfalfa hay or meal in the ration, and will reduce by about 25 percent the grain required to produce a unit of gain. Furthermore, the protein con-

tent of the grain ration can be about 2 percent lower. (These factors account for the differences between Table III and Table IV.)

2. Use skim milk, buttermilk, whey, etc. One gallon of skim milk or buttermilk per day balances the ration of pigs fed corn. Whey has about one-half the value of skim milk.
3. Use mungbeans. Cracked beans may be used as a source of protein even though sound beans are too high in price. Mungbeans can replace vegetable sources of protein but are not a substitute for animal protein.
4. Use alfalfa hay. For dry-lot feeding, properly cured, fine-stemmed, leafy alfalfa hay may be ground and fed in amounts up to 15 percent of the ration for pigs weighing over 150 pounds. Not more than 5 percent should be included in the ration for smaller pigs. Average alfalfa hay is of little value in a swine ration. Only No. 1 extra green, extra leafy hay should be considered.
5. Change the protein content of the ration according to the weight of the pigs. Feed a ration high in protein when the pig is small and reduce it as the pig becomes older. The proportion of animal protein can also be reduced as the pigs become older.

DAIRY COWS

Milk Cows.

The type of grain mixture fed dairy cows depends entirely on the kind of roughage used. Table V shows the kind and amount of mixture to be fed with different kinds of roughages. No protein supplement is needed when cows are on immature pasture (prior to bloom or heading stage), or are fed legume hays such as alfalfa, soybean, sweet clover, peanut, or mungbean hay. Generous amounts of protein supplements must be added to the grain fed when the roughage is corn or sorghum silages, fodders, prairie hay, or hay made from mature cereals or grasses.

ROUGHAGE.—Full advantage should be taken of good roughages, since this is the basis of a dairy cow's ration. High quality roughage may easily have double the feeding value of low quality roughage. Ample legume roughage will eliminate the need for protein supplement in most cases. For each increase of 1 percent in the protein content of the roughage used, the protein content of the grain mixture can be reduced approximately 2 percent.

PASTURE.—Immature pasture grass is the cheapest as well as the best source of nutrients. A heavy producing cow, however, cannot consume enough bulky pasture grass to supply her whole need for protein.

SILAGE.—Silages are usually very low in protein but are a valuable and abundant source of nutrients. Corn should be cut for silage when glazed and denting. Sorghums should be in the hard dough stage. Immature grasses or legume crops may be put in the silo to provide a high protein roughage. Some preservative such as molasses, ground corn or sweet sorghum fodder is advisable with these latter crops. Mungbean silage is a good source of protein and vitamin A. No preservative is needed in making mungbean silage.

VITAMINS AND MINERALS.—Green pasture, or (in winter) green hay, will supply vitamin A, which is the vitamin most likely to be deficient in a dairy cow's ration.

Medium amounts of good legume hay will supply sufficient calcium. Bran or protein supplements such as cottonseed meal will supply the phosphorus needed by cows of

TABLE V.—Kind and Amount of Grain and Supplement for Various Roughages; Dairy Cows.

	JERSEYS OR GUERNSEYS		HOLSTEINS, AYRSHIRES OR BROWN SWISS	
	Grain or Mixture	Lbs. per Gal. of Milk Produced	Grain or Mixture	Lbs. per Gal. of Milk Produced
High protein: Good green pasture or ample legume hay	A	3 to 3½	A	3 to 3½
Medium protein: Mixture of equal parts legume hay and low-protein roughage; or one part legume hay and two parts silage	B	3 to 3½	B	2 to 2½
Low protein: Silage (corn or sorghum), prairie hay, or other grass hays and fodders	C	3½ to 3¾	C	2½ to 2¾

Grain or mixture:—

A—Farm grains only. (Corn, oats, barley, sorghum grain, etc.) No additional supplement needed.

B—A 12% protein grain mixture. One part high-protein supplement and eight to ten parts farm grains.

C—A 20% protein grain mixture. One part high-protein in supplement and two parts farm grains.

The high-protein supplement may be cottonseed meal, soybean meal, peanut meal, or other meals containing 40 to 45 percent protein.

medium production. High producers and cows not fed as above should have free access to a mixture of equal parts of steamed bone meal, finely ground limestone, and salt.

Calves.

The young calf should receive whole milk from birth to three or four weeks of age and limited amounts of wholemilk or skim milk if available, for several weeks thereafter. As milk is high in protein, it is unnecessary to use any protein concentrate in the calf's grain ration. While on milk, feed up to three pounds of ground or whole farm grains.

After weaning, the type of grain mixture fed the calf will depend on the type of roughage used. With abundant good quality legume hay, no protein concentrate in the grain mixture is necessary. Even with part legume hay, good growth can be obtained from the use of farm grains alone. With low protein roughage, such as prairie hay, a 16 to 18 percent protein grain mixture should be used. Pasture grass should not be depended upon as a roughage for calves until they are at least four months old.

Young Stock

Rapid growth is desirable, but young dairy animals should not be allowed to get fat. Roughage should be fed in unlimited amounts. The protein required in the grain mixture will vary with the type of roughage used, as in the case of calves.

Heifers from twelve months of age up to within three months of calving should be limited in most cases to not over two or three pounds of grain daily. The last three months before freshening, a heifer should receive eight to ten pounds of grain daily, or sufficient to get her in good flesh at calving time.

POULTRY

The amount of animal protein recommended by the Oklahoma A. and M. College Poultry Department for chickens is slightly greater, and the amount for turkeys is considerably greater, than the amount proposed by some agencies for war-time use. (See Table VI for Oklahoma recommendations.)

Experience in feeding turkey poults over a period of years at Oklahoma A. and M. College has definitely proved that it is an expensive and wasteful practice to try to skimp on the protein in turkey starters. Only when the protein combination is of the highest quality, through use of large percentages

of the scarce animal proteins, can the minimum amount of protein be used with satisfactory results. When less efficient protein combinations are used, more protein must be included in the ration.

To produce the maximum amount of turkey meat the birds must be fed for most efficient production and fed to heavier weights than normal.

Use home produced protein to the maximum.

Green Pastures

Good green feed, grown on rich soil, if fed at least once every day, contains vitamins in sufficient amounts to supply the needs of poultry and contributes some valuable protein.

Where good soil is available, it is possible by proper planning to supply green feed in abundance to poultry every day throughout the year.

Alfalfa Hay

Alfalfa products when fed in sufficient amounts will furnish ample riboflavin and the B-complex vitamins. Those who have alfalfa growing on the farm can produce their own alfalfa meal. Five pounds of well cured green alfalfa meal will furnish a supply for 100 hens for one year and for replacement chicks to 24 weeks of age. Hay for this purpose should be cut a little earlier than for ordinary hay purposes, so as to have more tender stems and a larger percentage of leaves. It must be cured without sunburn or bleach from rain in order to maintain full vitamin efficiency.

TABLE VI.—*Protein Content Recommended for Poultry Feeds.*

Type of Feed	Total Protein (Percent)	Animal Protein (Percent)
Chick starter	19	4.00
Chick growing mash*	20	3.00
Broiler mash*	18	3.00
Laying mash***	20	3.00
Poultry supplement*	30	4.00
Turkey starter	24	5.50
Turkey growing mash*	20	3.00

* To be fed with grain.

** To be fed with a limited amount of grain.

*** For chicken or turkey hens. To be fed with grain.

Liquid Skim Milk

Liquid skim milk which cannot be used for human consumption can replace up to 75 percent of the concentrated protein feeds if it is regularly available and enough can be supplied to furnish all of the liquids the birds require. In other words, it must replace water. The milk dishes must be kept clean, also the litter around these containers should be free from contamination. Special effort should be made to prevent contamination from flies.

Mung Beans

Green colored mung beans in experiments at this Station have given promise, when ground, of being good vegetable protein supplements in chicken and turkey rations. One-half acre of mung beans will produce enough to grow 100 pullets to laying age, using 25 percent of ground beans in the growing mash.

Feeding Recommendations

CHICKS.—Feed enough protein to chicks the first three weeks of life to give them the start needed for most efficient growth to maturity for either meat or eggs. After chicks have been well started they can utilize rations lower in animal protein without reducing their growth materially. The chicks can be changed to a growing mash after three weeks and grain added at about five weeks.

BROILERS AND FRYERS.—Feed enough protein to develop meat birds at maximum growth rate in order to avoid any period of non-growing maintenance and to finish the birds in the shortest possible time. This can be accomplished by starting the broilers on the same starting mash recommended for chicks above, changing to a broiler developing mash at three weeks, and adding grain at five weeks. Broilers are usually fed a limited amount of grain, rather than all they will eat.

HENS.—Feed enough protein to maintain maximum rate of production while hen is laying. Use hens for meat immediately when they cease to lay if they are not suitable to retain for another laying season.

Laying hens are commonly fed a laying mash and a grain mixture. Green pasture will aid in reducing the amount of feed needed for good production. Liquid milk may be fed to hens if available, but milk is best utilized by young growing animals if the supply is limited.

TURKEYS.—Feed turkey poults enough protein to support maximum growth during the first six weeks of life. Young poults require much less feed to produce a pound of gain than do turkeys approaching market age. There is a saving of both protein and total feed when poults are started on an adequate ration. Other advantages are lower mortality during the brooding period and less shock when poults are transferred to the range.

Growing mash may be fed when the poults are six weeks old and grain added at twelve to fourteen weeks. The turkey growing mash may be the same as the chick grower.

HELPFUL PUBLICATIONS

(These publications of the Oklahoma Agricultural Experiment Station are available free from county agents or by writing: *Mailing Clerk, Experiment Station, Stillwater, Okla.*)

- B-268, "Feed—Per Acre and Per Hour."
- B-262, "Experiments in Creep-feeding Beef Calves."
- B-244, "Feeding Laying Hens," and Supplement to Bul. B-244, "Wartime Poultry Feeds."
- B-236, "Turkey Production."
- B-228, "Fattening Western Lambs."
- C-114, "Meeting Wartime Sheep Production Goals."
- C-112, "Meeting Wartime Beef Production Goals."
- C-111, "Fiber and Protein in Turkey Rations: Substitutes to Meet Wartime Needs."
- C-108, "Seeding Native Grasses."
- C-104, "Mung Beans for Oklahoma."
- C-101, "Mungbean Hay and Mungbean Silage for Milk Production."
- C-94, "Sweet Clover for Soil Improvement."
- C-83, "Climatic Conditions and Suggested Cropping Systems for Northwestern Oklahoma."
- M-90, "Wheat, Mungbeans, and Prairie Hay in Lamb Fattening Rations."
- M-91, "Producing Choice Finished Yearlings with a Maximum of Roughage and Grass and a Minimum of Grain."
- M192, "Fattening Two-year-old Steers on Bluestem Grass."
- M-92, "The Preparation of Wheat for Growing and Fattening Swine."
- M-94, "The Preparation of Barley for Fattening Swine."
- M-95, "Ground Wheat vs. Ground Shelled Corn for Fattening Beef Calves."
- M-97, "A Comparison of Cottonseed Cake, Soybean Pellets, Oats and Ground Kafir as Supplements to Silage in Wintering Steer Calves."
- M-96, "A Preliminary Report of the Digestibility and Feeding Value of Native Grass."
- M-98, "A System of Summer Grazing Plus the Winter Feeding of Prairie Hay vs. Year-long Grazing for the Commercial Cow Herd on Bluestem Ranges."

